Field Evaluation of Almond Varieties

Project No.: **17-HORT2-Lampinen**

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Objectives:

The objective is to evaluate new almond varieties and selections in replicated trials at three locations in the almond growing areas of California.

Interpretive Summary:

The next generation Regional Almond Variety Trials were planted in the winter of 2014 in Butte, Stanislaus and Madera counties. Rows of Nonpareil were alternated with 29 varieties and/or selections at all 3 sites. Trees at the Butte, Stanislaus and Madera trial were planted on Krymsk 86, Nemaguard and Hansen 536 rootstocks respectively (with the exceptions listed at the bottom of **Table 5**). Unlike the previous generation Regional Almond Variety Trials, there are four replications of each of the varieties and selections at each of the three sites in the 2014 trials. Bloom overlap of pollenizers with Nonpareil was generally good at all the sites except for UCD 3-40. Yields at the three trials were higher than the previous generation trials likely due at least in part to higher planting densities. Main kernel defects observed in 2016 were doubles, twins, navel orangeworm damage, blanks and severe shrivel.

Materials and methods:

Regional Almond Variety Trials Planted in 2014

The next generation almond variety trials were planted in the winter of 2014 in Butte (Chico State University), Stanislaus (Salida School District Site), and Madera (Chowchilla grower site) counties. The varieties and selections planted are listed in (**Table 1**). The first 30 items are common to all 3 sites and a few different items added at individual sites are listed at the bottom of (**Table 1)**. Trees at the Butte, Stanislaus and Madera trial were planted on Krymsk 86, Nemaguard and Hansen 536 rootstocks respectively (with the exceptions listed at the bottom of (**Table 1**). Trees were planted at a spacing of 18' x 22' at the Butte site (110 trees/acre), 16' x 21' at the Stanislaus site (130 trees/acre) and 12' x 21' at the Madera site (173 trees/acre). These densities are significantly higher than the previous generation RAVTs where planting densities for the Butte, San Joaquin and Kern trials were 64, 75 and 86 trees per acre respectively. Of the items planted in the main trials, fourteen are either partially or fully self-fertile (**Table 1**).

Bloom, hullsplit, canopy light interception and yield data collection were initiated in 2016. Bloom data were collected approximately every three days and recorded as onset of bloom, full bloom, and the end of petalfall. Hullsplit was recorded from the beginning of the first non-blank splits to completion of hullsplit.

Results and Discussion:

General observations for each site

Butte. The winter of 2016-2017 was very wet in Butte County with roughly 40.3 inches of rain measured in Chico. This is 13.8 inches greater than the Chico long term average. The spring 2017 growing season experienced 7.7 inches of rainfall in February, 3.1 inches in March, 3.4 inches in April, and 0.8 inches in May. These wet in-season conditions likely increased disease pressure at this site.

Varieties with noticeable twig dieback (cause unknown) occurring mostly on low and interior canopy shaded twigs included UCD 8-27, Winters, Supareil, UCD 1-232, Self-Fruitful P13.019, and Y 117-86-03. Some varieties also had more hull rot at harvest than others, these included Folsom, UCD 3-40, Supareil, UCD 8-160, Eddie, UCD 1-232, UCD 8-201, and Capitola. Finally, bacterial spot symptoms continue to be documented and were observed on UCD 18-20, UCD 1-271, Booth, Self-Fruitful P13.019, and Self-Fruitful P16.013, with a slight case on Aldrich in 2017.

With only three shakes in the 2017 harvest, many varieties were not shaken at 100% hull split. They continued to dry for prolonged periods and had poor nut removal as a result. With unsatisfactory nut removal and very high mummy counts on many varieties (see **Table 7**), we hope this can be improved with four harvests planned in 2018.

Stanislaus. Trees in the Stanislaus RAVT have grown about average for trees on Nemaguard rootstock, although there have been some problems. In 2015 (second

leaf), many trees in the trial exhibited signs of Verticillium wilt, and to a lesser degree in 2016. In 2016, a significant portion of the field suffered drift injury from an errant, aerial application of glyphosate and glyphosonate to an adjacent field. This herbicide drift occurred during bloom and appeared to have affected 3rd-leaf nut set / retention throughout much of the field. Trees appear to have recovered and no long-term deleterious effects are expected. Beginning in 2016 and continuing through 2017, over 15% of the Nonpareil trees have had moderate to severe signs of band canker (*Botryosphaeria* spp.). Approximately 100 Nonpareil trees will be replaced. Relatively few of the test variety trees showed obvious band canker symptoms although Y121-42-99, Sterling and Kester on Hansen rootstock appear to have been disproportionately affected.

Madera. A number of trees at the Madera site have died. The majority of deaths have been in two sections with infiltration issues in blocks three and four (see areas with missing trees in (**Figure 4**). The rest have been scattered throughout the site, mostly of undetermined causes, although a few Nonpareil and Wood Colony deaths have been due to bark damage. Remaining missing trees will be replaced by next spring.

As for diseases, in the spring many trees showed shot-hole like symptoms. However, samples were not tested to confirm this. Additionally, many varieties were suffering from cankers. All Y121-42-99 trees in block one had cankers on lower limbs leading to lower limb death and a few trees also had trunk cankers. Multiple Jenette trees also had cankers in blocks one and two, however this variety was not affected as badly. In late July branch samples were sent to the Trouillas Laboratory at Kearney Research and Extension Center. The lab only found saphrophytic fungi present so the cause of the cankers is unknown. Other varieties suffered from occasional branch cankers, but not at a high enough frequency to be noted.

Bloom, Hullsplit, Yield and Quality

2016

Bloom was very compact at all 3 sites in 2016 (**Figure 1**). Overlap with Nonpareil was good for everything except UCD 3-40 which was quite early at all sites. Bee flying hours during Nonpareil bloom for 2016 are shown in (**Table 2)**.

Midday canopy photosynthetically active radiation interception (PAR) was collected using the mobile platform light bar in June 2016 (**Table 3, 4 and 5**). PAR interception varied from 20 to 43 percent at the Butte trial, 23 to 36 percent at the Stanislaus trial and 23 to 61 percent at the Madera trial. The level of PAR interception at the Madera site is among the highest we have seen for an almond orchard this age. This is partly due to the high tree density (173 trees/acre) and vigorous Hansen peach x almond rootstock.

Hullsplit data for 2016 is presented in the top of (**Figure 2)**. Completion of hullsplit ranged from August 3 to September 6 at the Butte trial. At the Stanislaus trial it ranged from July 15 to August 22. At the Madera trial it ranged from July 21 to August 17.

Yield data for 2016 is shown in (**Table 3, 4 and 5**). Yields at the Butte and Stanislaus sites ranged from about 100 to 800 kernel pounds per are which is about normal for a 3rd leaf orchard but those at the Madera site were among the highest we have seen for a 3-year-old orchard (up to 2000 kernel pounds per acre). The yields for the 2014 trials versus those for previous generation trials is shown in (**Figure 3**). The yields for the 2014 Butte and Stanislaus trials were greater than those for the 1993 trials at a similar age but the Madera yields were significantly higher (and slightly higher than those from the McFarland trial). (**Figure 6**) shows the relationship between midday canopy photosynthetically active radiation interception and yield by site. Although there is a relationship at each site, the overall relationship is quite different for each site. This is likely due to a combination of planting density variability, management differences and weather-related issues. Note that yields at Butte site were higher than those at the Stanislaus site despite the higher planting density at Stanislaus. This is likely due to the previously noted issues with disease as well as herbicide damage at the Stanislaus site.

Yield efficiency (expressed as yield per unit PAR intercepted) is presented in (**Table 3, 4 and 5**). This is a useful piece of data since it can show whether a new variety or selection is more efficient at producing yield per unit PAR intercepted or whether it is yielding more simply because it is growing faster. This will be important data to follow as the orchards develop but may or may not be meaningful at this early stage.

The relative number of mummies left on the tree after shaking were estimated at the Madera trial in 2016 (**Table 6**). Although this may give some estimation of relative ease of shaking, it should be noted that many varieties were harvested together for convenience. Therefore, some varieties or selections were likely harvested before or after their ideal harvest timing, so these results should be considered with that in mind.

The main kernel defects observed in 2016 were double kernels, twin kernels, naval orangeworm damage, and severe shrivel (**Table 8**). A double kernel results when both ovules develop within the nut resulting in two kernels within the nut, each with a separate seed coat or pellicle. A twin kernel result when two embryos develop within a single pellicle. Defects are listed if they have equal to or greater than 6% incidence.

2017

In 2017 bloom was much more protracted (right side of **Figure 1**), due to extended periods of rain and clouds at all 3 sites. Bee flying hours during Nonpareil bloom are shown in (**Table 2**). Bloom overlap with Nonpareil was again good for all pollenizers except UCD 3-40 (**Figure 1**).

Hullsplit at the Madera site started earlier and was completed significantly earlier than at either of the other sites in 2017 (**Figure 2**). In general, the patterns at all 3 sites in 2017 was quite similar to the patterns observed in 2016 (**Figure 2**).

Yields in 2017 continued to be high relative to the yields at a similar age from the previous generation Butte, Delta and Kern variety trials (**Figure 3, Table 3-5**). Yields were more similar among the sites in 2017 compared to 2016 with the highest yielding cultivars producing 2145, 2058 and 2604 kernel pounds per acre at the Butte,

Stanislaus and Madera sites respectively (**Table 3, 4, 5 and Figure 3**). There was a fair amount of tree loss at both the Madera and Stanislaus sites (**Figure 4**). Most of these trees have been replanted.

Yield efficiency (expressed as yield per unit PAR intercepted) is presented in (**Table 3, 4, and 5**). We have found that our best orchards and varieties can produce in the range of 50 kernel pounds per 1% PAR intercepted. In 2017, yield efficiency ranged from 7 to 43 for the Butte site, 19 to 54 for the Stanislaus site and 11-44 for the Madera site. This is a useful piece of data since it can show whether a new variety or selection is more efficient at producing yield per unit PAR intercepted or whether it is yielding more simply because it is growing faster. These data suggest there is room for improvement at all 3 sites and these values are likely to increase as the orchards mature.

The relationship between midday PAR interception and yield for 2016 for all varieties and selections at each site is shown in (**Figure 5**). In general, more PAR interception led to higher yields but there is a lot of scatter in the data suggesting there are differences among varieties and selections. The equivalent data for 2017 are shown in the top of (**Figure 6)** and for the cumulative yield in the bottom of (**Figure 6).**

The number of mummies left on the trees after harvest were rated at all three sites in 2017 and results are shown in (**Table 7)**. Again, it is important to remember that all varieties and selections were likely not shaken at their ideal development stage due to large number of items in these trials.

The main kernel defects observed in 2017 were similar to those observed in 2016 including double kernels, twin kernels, naval orangeworm damage, and severe shrivel (**Table 9**). Defects are listed if they have equal to or greater than 6% incidence.

Tree architecture

We are working on methodology to assess tree architecture. For details about our current strategies see Tom Gradziel's report on the Almond Breeding Program report. We plan to discuss this at the Almond Workgroup meeting this coming December. We have the Mule light bar photos from all years allowing us to go back and assess canopy structure from the beginning of the study once we decide on the best options for rating this.

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Table 1. Varieties and selections planted at the next generation regional almond variety trials. Items 1-29 are planted at all 3 sites while additional material planted at individual sites is listed at the end. Trees at the Butte, Stanislaus and Madera sites were planted on Krymsk 86, Nemaguard and Hansen 536 rootstock respectively (exceptions are noted at bottom of table).

Varieties for 2014 Almond Regional Variety Trials			
#	Variety or selection	Self-fertile*	Source
1	Eddie		Bright's
2	Capitola		Burchell
3	Supareil		Burchell
4	Self-fr P13.019	yes	Burchell
5	Self-fr P16.013	yes	Burchell
6	Booth		Burchell
7	Sterling		Burchell
8	Bennett		Duarte
9	Nonpareil		Fowler
10	Durango		Fowler
11	Jenette		Fowler
12	Winters	partial	UCD
13	Sweetheart	partial	UCD
14	Kester (2-19E)		UCD
15	UCD3-40		UCD
16	UCD18-20		UCD
17	UCD1-16		UCD
18	UCD8-160	yes	UCD
19	UCD8-27	yes	UCD
20	UCD1-271	yes	UCD
21	UCD1-232	yes	UCD
22	UCD7-159	yes	UCD
23	UCD8-201	yes	UCD
24	Y121-42-99	yes	USDA
25	Y117-86-03	yes	USDA
26	Y116-161-99	yes	USDA
27	Y117-91-03	yes	USDA
28	Folsom		Wilson
29	Aldrich		

* of the twenty nine varieties in the main trials fourteen are either partially or fully self-fertile (as is Lonestar- see below)

Additional items

Butte site- Wood Colony on Kyrmsk 86, one rep of Lone Star (self-fertile and one year younger) on Krymsk 86

Madera site- Wood Colony added

Butte and Stanislaus sites- Kester on Hanson 536 in addition to on normal site rootstock

Stanislaus site- one rep of Lonestar (self-fertile) on Nemaguard

Table 2. Bee flying hours during Nonpareil bloom by site for 2016 and 2017. Bee flying hours were calculated as daylight hours with air temperature greater than or equal to 55°F, windspeed less than or equal to 15mph, and no precipitation.

Site	2016	2017
Butte	80	119
Stanislaus	101	104
Madera	83	127

Table 3. Yield, midday canopy light interception and yield per unit PAR intercepted for the 2016 (top), and 2017 years (middle) and cumulative yield for both years (bottom) for the Butte RAVT.

2016

Butte

# reps	Variety or selection	Yield (kernel lbs/ac)
4	Booth	796 a
4	Self-fruitful P13.019	764 a b
4	UCD18-20	717 a b c
4	UCD1-232	712 a b c
4	UCD8-160	670 a b c d
4	Kester (2-19e)	649 a b c d e
4	Kester (2-19e) / Hansen	609 b c d e f
4	self-fruitful P16.013	577 b c d e f
4	UCD1-16	556 c d e f g
4	Y116-161-99	529 c d e f g h
4	Folsom	523 d e f g h
4	UCD8-201	517 d e f g h
4	UCD8-27	507 d e f g h i
4	**Nonpareil**	**482 d e f g h i j**
4	Y117-91-03	481 d e f g h i j
4	Winters	469 e f g h i j k
4	Y117-86-03	460 e f g h i j k l
4	Capitola	455 e f g h i j k l
4	Eddie	447 f g h i j k l
4	Wood Colony	419 f g h i j k l
4	Durango	390 g h i j k l m
4	UCD3-40	347 h i j k l m n
4	Sterling	336 h i j k l m n
4	Aldrich	316 i j k l m n
4	Sweetheart	311 i j k l m n
4	Supareil	308 j k l m n
4	Bennett	291 j k l m n
4	Jenette	271 l m n
4	UCD7-159	211 m n
4	UCD1-271	159 n

# reps	Variety or selection	Midday canopy PAR interception (%)
4	UCD8-160	29.5 a
4	self-fruitful P16.013	28.9 a b
4	Booth	23.9 a b c
4	Y116-161-99	22.7 b c d
4	UCD1-232	22.4 b c d e
4	UCD18-20	21.4 c d e f
4	UCD1-16	20.0 c d e f g
4	UCD8-27	19.6 c d e f g h
4	Eddie	19.4 c d e f g h
4	UCD8-201	19.4 c d e f g h
4	Self-fruitful P13.019	19.3 c d e f g h
4	Kester (2-19e)	19.2 c d e f g h
4	Wood Colony	18.1 c d e f g h i
4	Y117-86-03	16.2 d e f g h i j
4	Folsom	15.7 d e f g h i j k
106	**Nonpareil**	**15.2 e f g h i j k l**
4	Y117-91-03	14.4 f g h i j k l
4	Winters	14.3 f g h i j k l
4	Kester (2-19e) / Hansen	14.2 f g h i j k l
4	Durango	13.4 g h i j k l
4	Aldrich	12.7 g h i j k l
4	Bennett	12.7 g h i j k l
4	Capitola	12.3 h i j k l
7	UCD3-40	12.2 h i j k l
4	Sterling	12.1 h i j k l
4	Jenette	11.1 i j k l
4	Sweetheart	10.6 j k l
4	Supareil	9.9 j k l
4	UCD7-159	8.2 k l
4	UCD1-271	7.9 l

# reps	Variety or selection	Yield per unit PAR intercepted
4	Kester (2-19e) / Hansen	43.0 a
4	Self-fruitful P13.019	39.6 a b
4	Capitola	37.5 b c
4	UCD18-20	33.7 c d
4	Y117-91-03	33.6 c d
4	Kester (2-19e)	33.6 c d
4	Booth	33.3 c d e
4	Folsom	33.2 c d e
4	Winters	32.7 c d e
4	UCD1-232	32.0 d e f
4	**Nonpareil**	**31.7 d e f g**
4	Supareil	31.2 d e f g h
4	Durango	29.0 d e f g h i
7	UCD3-40	28.7 d e f g h i j
4	Y117-86-03	28.3 d e f g h i j
4	Sterling	28.0 e f g h i j
4	UCD1-16	27.8 e f g h i j
4	UCD8-201	26.7 f g h i j
4	Sweetheart	26.2 g h i j k
4	UCD7-159	26.0 h i j k
4	UCD8-27	25.9 h i j k
4	Eddie	25.0 i j k l
4	Aldrich	25.0 i j k l
4	Jenette	24.3 i j k l
4	Wood Colony	23.4 i j k l
4	UCD8-160	23.2 j k l
2	Y121-42-99	23.2 j k l
4	Y116-161-99	23.1 j k l
4	Bennett	20.8 k l
4	UCD1-271	20.7 k l
4	self-fruitful P16.013	20.2 l

2017

Butte

# reps	Variety or selection	Yield (kernel lbs/ac)
124	**Nonpareil**	**2145 a**
4	Winters	2040 a b
4	Booth	1982 a b c
4	UCD18-20	1933 a b c
4	UCD1-232	1869 a b c
4	UCD8-160	1708 a b c d
2	Y121-42-99	1597 a b c d e
4	Folsom	1583 a b c d e
4	Jenette	1524 a b c d e f
4	Y117-91-03	1500 a b c d e f
4	Capitola	1500 a b c d e f g
4	UCD8-201	1405 b c d e f g
4	Wood Colony	1382 b c d e f g
4	Durango	1271 c d e f g h
4	Self-fruitful P13.019	1117 d e f g h i
4	Kester (2-19e)	1114 d e f g h i
4	UCD8-27	1105 d e f g h i
4	Eddie	1090 d e f g h i
4	Kester (2-19e) /Hansen	1060 d e f g h i
4	Aldrich	1031 d e f g h i
4	UCD7-159	1019 d e f g h i
4	UCD1-16	964 d e f g h i
4	Y117-86-03	932 e f g h i
4	Sterling	922 e f g h i
4	Bennett	902 e f g h i
4	Y116-161-99	823 f g h i
4	Supareil	773 f g h i
4	UCD3-40	735 g h i
3	self-fruitful P16.013	712 g h i
4	Sweetheart	526 h i
4	UCD1-271	405 i

# reps	Variety or selection	Midday canopy PAR interception (%)
4	Kester (2-19e) /Hansen	67.3 a
4	Capitola	66.1 a b
4	UCD18-20	62.4 a b c
4	Y117-91-03	60.5 a b c d
4	Kester (2-19e)	59.5 a b c d
124	**Nonpareil**	**59.1 a b c d e**
4	Booth	58.2 b c d e f
4	Self-fruitful P13.019	57.7 b c d e f
4	Sterling	55.6 c d e f g
4	Folsom	55.6 c d e f g
4	Winters	55.5 c d e f g
4	Supareil	55.1 c d e f g
4	Sweetheart	54.3 c d e f g h
4	Durango	54.2 c d e f g h
4	UCD3-40	51.7 d e f g h i
4	UCD1-16	50.6 e f g h i j
4	UCD7-159	50.5 e f g h i j
4	Y117-86-03	49.6 f g h i j
4	UCD8-201	49.5 f g h i j
4	UCD8-27	48.8 g h i j k
4	Eddie	48.3 g h i j k l
4	UCD1-232	47.4 g h i j k l
4	Aldrich	46.6 h i j k l
4	Jenette	44.5 i j k l m
4	Y116-161-99	42.6 j k l m n
2	Y121-42-99	41.0 k l m n o
4	Bennett	40.7 k l m n o
4	Wood Colony	40.2 l m n o
4	UCD8-160	37.7 m n o
4	UCD1-271	37.1 m n o
4	self-fruitful P16.013	35.3 n o

# reps	Variety or selection	Yield per unit PAR intercepted
3	UCD8-160	43.1 a
3	UCD1-232	41.6 a
2	Y121-42-99	38.9 a b
155	**Nonpareil**	**35.9 a b c**
4	Wood Colony	34.4 a b c d
4	Jenette	34.3 a b c d
2	Winters	34.3 a b c d
4	Booth	34.2 a b c d
3	UCD18-20	30.3 a b c d e
4	UCD8-201	29.5 a b c d e f
4	Folsom	28.7 a b c d e f
4	Y117-91-03	24.8 b c d e f g
4	Durango	23.1 c d e f g
4	UCD8-27	22.8 c d e f g
4	Capitola	22.6 c d e f g
4	Aldrich	22.1 c d e f g h
4	Eddie	21.5 c d e f g h
4	Bennett	20.9 c d e f g h
4	Y116-161-99	20.2 d e f g h
4	UCD7-159	20.2 d e f g h
3	self-fruitful P16.013	19.8 d e f g h
4	Self-fruitful P13.019	19.4 d e f g h
4	UCD1-16	19.0 d e f g h
4	Kester (2-19e)	18.8 d e f g h
3	Sterling	18.5 e f g h
4	Y117-86-03	18.5 e f g h
4	Kester (2-19e) /Hansen	15.6 e f g h
4	Supareil	14.0 f g h
4	UCD1-271	10.9 g h
4	Sweetheart	9.2 g h
4	UCD3-40	6.7 h

Cumulative 2016-2017

Butte

# reps	Variety or selection	Yield (kernel lbs/ac)
4	Booth	2778 a
4	UCD18-20	2650 a b
4	UCD1-232	2581 a b c
108	**Nonpareil**	**2579 a b c**
4	Winters	2509 a b c d
4	UCD8-160	2379 a b c d e
4	Folsom	2106 a b c d e f
4	Y117-91-03	1981 b c d e f g
4	Capitola	1955 b c d e f g
4	UCD8-201	1922 c d e f g h
4	Self-fruitful P13.019	1881 c d e f g h
4	Wood Colony	1801 d e f g h i
4	Jenette	1795 d e f g h i
4	Kester (2-19e)	1763 e f g h i
4	Kester (2-19e) /Hansen	1669 e f g h i
4	Durango	1662 e f g h i
4	UCD8-27	1612 f g h i
4	Eddie	1537 f g h i j
4	UCD1-16	1520 f g h i j
4	Y117-86-03	1392 f g h i j
4	Y116-161-99	1352 g h i j
4	Aldrich	1347 g h i j
3	self-fruitful P16.013	1314 g h i j
4	Sterling	1258 g h i j k
4	UCD7-159	1230 g h i j k
4	Bennett	1193 h i j k
4	Supareil	1081 i j k
4	UCD3-40	1077 i j k
4	Sweetheart	838 j k
4	UCD1-271	565 k

Table 4. Yield, midday canopy light interception and yield per unit PAR intercepted for the 2016 (top), and 2017 years (middle) and cumulative yield for both years (bottom) for the Stanislaus RAVT.

2016

Stanislaus

# reps	Variety or selection	Yield (kernel lbs/ac)										
4	Self-fruitful P13.019	460	a									
4	Y121-42-99	373	a	b								
4	UCD1-16	357	a	b	c							
3	Kester (2-19e) / Hansen	345	a	b	c	d						
4	Bennett	334	a	b	c	d	e					
4	Y116-161-99	325	a	b	c	d	e	f				
3	Kester (2-19e)	321	a	b	c	d	e	f	g			
4	Eddie	309	a	b	c	d	e	f	g	h		
4	Folsom	281	a	b	c	d	e	f	g	h	i	
4	UCD18-20	262		b	c	d	e	f	g	h	i	
4	UCD1-232	225		b	c	d	e	f	g	h	i	j
4	UCD8-160	224		b	c	d	e	f	g	h	i	j
4	Y117-86-03	213		b	c	d	e	f	g	h	i	j
4	Winters	195		b	c	d	e	f	g	h	i	j
16	**Nonpareil**	**179**			**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**
4	Sweetheart	178			c	d	e	f	g	h	i	j
4	UCD8-27	178			c	d	e	f	g	h	i	j
4	Y117-91-03	177			c	d	e	f	g	h	i	j
4	Aldrich	162			c	d	e	f	g	h	i	j
4	Durango	159				d	e	f	g	h	i	j
4	self-fruitful P16-013	149					e	f	g	h	i	j
4	UCD3-40	133						f	g	h	i	j
4	Booth	128							g	h	i	j
4	Capitola	123								h	i	j
4	UCD8-201	123								h	i	j
4	Jenette	120								h	i	j
4	UCD1-271	86									i	j
4	Sterling	54										j
3	Supareil	53										j
4	UCD7-159	40										j

# reps	Variety or selection	Midday canopy PAR interception (%)										
4	UCD1-16	13.6	a									
4	Self-fruitful P13.019	13.3	a	b								
4	Y116-161-99	12.7	a	b	c							
4	Bennett	12.4	a	b	c							
4	Y121-42-99	11.9	a	b	c	d						
3	Kester (2-19e)	10.4	a	b	c	d	e					
4	Eddie	10.2	a	b	c	d	e					
3	Kester (2-19e) / Hansen	9.6	a	b	c	d	e	f				
4	Folsom	8.6		b	c	d	e	f	g			
4	Y117-86-03	8.6		b	c	d	e	f	g			
4	UCD18-20	8.5		b	c	d	e	f	g			
4	UCD8-160	8.4		b	c	d	e	f	g			
4	UCD1-232	7.7			c	d	e	f	g	h		
4	Winters	7.2				d	e	f	g	h		
4	UCD8-27	7.1				d	e	f	g	h	i	
4	Durango	6.9					e	f	g	h	i	j
16	**Nonpareil**	**6.7**					**e**	**f**	**g**	**h**	**i**	**j**
4	Sweetheart	6.6					e	f	g	h	i	j
4	Aldrich	6.3					e	f	g	h	i	j
4	self-fruitful P16-013	5.7					e	f	g	h	i	j
4	Jenette	4.9						f	g	h	i	j
4	Y117-91-03	4.8						f	g	h	i	j
4	UCD8-201	4.7						f	g	h	i	j
4	UCD3-40	4.5						f	g	h	i	j
4	Capitola	4.4						f	g	h	i	j
4	Booth	4.2							g	h	i	j
4	UCD1-271	3.4							g	h	i	j
3	Supareil	2.0								h	i	j
4	Sterling	1.8										j
4	UCD7-159	1.7										j

# reps	Variety or selection	Yield per unit PAR intercepted										
4	Y117-91-03	35.7	a									
4	Kester (2-19e) / Hansen	35.6	a									
4	Self-fruitful P13.019	33.6	a	b								
4	Sterling	31.9	a	b	c							
4	Folsom	31.7	a	b	c							
4	Y121-42-99	31.7	a	b	c							
4	Booth	30.7	a	b	c	d						
4	UCD18-20	30.0	a	b	c	d						
4	UCD1-232	29.0	a	b	c	d						
4	UCD3-40	28.9	a	b	c	d						
4	Eddie	28.9	a	b	c	d						
4	Capitola	28.1		b	c	d						
4	Kester (2-19e)	28.1		b	c	d						
16	**Nonpareil**	**27.6**		**b**	**c**	**d**						
4	Winters	27.1		b	c	d						
4	Sweetheart	26.8		b	c	d						
4	UCD8-160	26.7		b	c	d						
4	Bennett	26.3		b	c	d						
4	UCD8-201	26.2			c	d						
4	Y116-161-99	25.7			c	d						
4	UCD1-16	25.5			c	d						
4	Supareil	25.5			c	d						
4	UCD1-271	25.3			c	d						
4	Aldrich	24.9			c	d						
4	Y117-86-03	24.7			c	d						
4	self-fruitful P16-013	24.6			c	d						
4	Jenette	24.1				d						
4	UCD8-27	23.7				d						
4	UCD7-159	23.5				d						
4	Durango	23.4				d						

2017

Stanislaus

# reps	Variety or selection	Yield (kernel lbs/ac)										
4	UCD8-160	2058	a									
4	UCD18-20	1971	a	b								
4	Y117-91-03	1918	a	b	c							
4	Self-fruitful P13.019	1783	a	b	c	d						
4	Aldrich	1675	a	b	c	d	e					
4	Kester (2-19e)	1648	a	b	c	d	e					
4	Kester (2-19e) / Hansen	1600	a	b	c	d	e					
4	UCD8-201	1569	a	b	c	d	e					
4	Booth	1550		b	c	d	e	f				
4	Winters	1544		b	c	d	e	f				
4	Y117-86-03	1536		b	c	d	e	f				
4	Bennett	1473		b	c	d	e	f	G			
3	Durango	1467		b	c	d	e	f	g			
3	Sterling	1465		b	c	d	e	f	g			
4	Y116-161-99	1437			c	d	e	f	g	h		
4	UCD7-159	1417			c	d	e	f	g	h	i	
4	Y121-42-99	1411			c	d	e	f	g	h	i	
4	**Nonpareil**	**1408**			**c**	**d**	**e**	**f**	**g**	**h**	**i**	
4	UCD1-232	1404			c	d	e	f	g	h	i	
4	Jenette	1396				d	e	f	g	h	i	
4	Capitola	1365				d	e	f	g	h	i	
4	Eddie	1285				d	e	f	g	h	i	
4	self-fruitful P16-013	1252					e	f	g	h	i	
4	Folsom	1241					e	f	g	h	i	
4	UCD1-271	1234					e	f	g	h	i	
4	UCD1-16	1223					e	f	g	h	i	
4	Supareil	1042						f	g	h	i	
4	UCD3-40	1016							g	h	i	
4	Sweetheart	936								h	i	
4	UCD8-27	907									i	

# reps	Variety or selection	Midday canopy PAR interception (%)										
4	Kester (2-19e) / Hansen	55.1	a									
4	Y117-91-03	53.4	a	b								
4	Booth	50.1	a	b	c							
4	Self-fruitful P13.019	49.8	a	b	c							
4	Sweetheart	49.6	a	b	c	d						
4	Sterling	48.6	a	b	c	d	e					
4	Folsom	48.2	a	b	c	d	e	f				
4	Capitola	46.4	a	b	c	d	e	f	g			
4	UCD18-20	46.0		b	c	d	e	f	g			
4	Y121-42-99	45.9		b	c	d	e	f	g			
4	UCD3-40	45.9		b	c	d	e	f	g			
4	Supareil	45.9		b	c	d	e	f	g			
4	Eddie	45.6		b	c	d	e	f	g			
4	UCD1-16	45.2		b	c	d	e	f	g			
4	Winters	44.7		b	c	d	e	f	g			
4	Kester (2-19e)	43.2			c	d	e	f	g			
4	UCD1-271	42.5			c	d	e	f	g			
4	UCD1-232	41.9			c	d	e	f	g			
4	Y116-161-99	41.3			c	d	e	f	g			
4	Bennett	41.1			c	d	e	f	g			
4	Jenette	40.9			c	d	e	f	g			
4	Y117-86-03	40.4				d	e	f	g			
4	UCD7-159	40.0					e	f	g			
4	Aldrich	39.9					e	f	g			
4	UCD8-27	39.8					e	f	g			
124	**Nonpareil**	**39.5**					**e**	**f**	**g**			
4	UCD8-201	39.1						f	g			
4	Durango	38.9						f	g			
4	self-fruitful P16-013	38.1							g			
4	UCD8-160	37.7							g			

# reps	Variety or selection	Yield per unit PAR intercepted										
4	UCD8-160	54.2	a									
4	UCD18-20	42.8		b								
4	Aldrich	41.7		b	c							
4	UCD8-201	39.6		b	c	d						
4	Y117-86-03	38.8		b	c	d	e					
3	Durango	37.9		b	c	d	e	f				
4	Kester (2-19e)	37.7		b	c	d	e	f	g			
4	**Nonpareil**	**37.7**		**b**	**c**	**d**	**e**	**f**	**g**			
4	Self-fruitful P13.019	36.0		b	c	d	e	f	g	h		
4	Y117-91-03	35.9		b	c	d	e	f	g	h		
4	Bennett	35.2		b	c	d	e	f	g	h		
4	UCD7-159	35.2		b	c	d	e	f	g	h		
4	Y116-161-99	34.6		b	c	d	e	f	g	h		
4	Winters	34.4		b	c	d	e	f	g	h		
4	Jenette	34.1			c	d	e	f	g	h	i	
4	UCD1-232	33.6			c	d	e	f	g	h	i	
4	UCD1-16	33.1			c	d	e	f	g	h	i	
4	self-fruitful P16-013	33.0				d	e	f	g	h	i	
4	Booth	30.6					e	f	g	h	i	j
4	Y121-42-99	30.4					e	f	g	h	i	j
3	Sterling	29.9						f	g	h	i	j
4	Kester (2-19e) / Hansen	29.1							g	h	i	j
4	Capitola	29.0							g	h	i	j
4	UCD1-271	28.9								h	i	j
4	Eddie	28.2								h	i	j
4	Folsom	25.8								h	i	j k
4	Supareil	22.9										j k
4	UCD8-27	22.8										j k
4	UCD3-40	22.2										j k
4	Sweetheart	18.8										k

Cumulative 2016-2017

Stanislaus

# reps	Variety or selection	Yield (kernel lbs/ac)								
4	UCD8-160	2282	a							
4	Self-fruitful P13.019	2243	a	b						
4	UCD18-20	2233	a	b						
3	Kester (2-19e)	2127	a	b	c					
4	Y117-91-03	2096	a	b	c	d				
4	Aldrich	1837	a	b	c	d	e			
3	Kester (2-19e) /Hansen	1809	a	b	c	d	e			
4	Bennett	1808	a	b	c	d	e			
4	Y121-42-99	1785	a	b	c	d	e			
4	Y116-161-99	1763	a	b	c	d	e			
4	Y117-86-03	1749	a	b	c	d	e	f		
4	Winters	1739	a	b	c	d	e	f		
4	UCD8-201	1692	a	b	c	d	e	f	g	
4	Booth	1678		b	c	d	e	f	g	h
3	Durango	1633			c	d	e	f	g	h
4	UCD1-232	1629			c	d	e	f	g	h
4	Eddie	1595			c	d	e	f	g	h
4	**Nonpareil**	**1587**			**c**	**d**	**e**	**f**	**g**	**h**
4	UCD1-16	1580			c	d	e	f	g	h
4	Folsom	1522				d	e	f	g	h
4	Jenette	1515				d	e	f	g	h
3	Sterling	1497				d	e	f	g	h
4	Capitola	1488					e	f	g	h
4	UCD7-159	1456					e	f	g	h
4	self-fruitful P16-013	1401					e	f	g	h
4	UCD1-271	1319					e	f	g	h
4	UCD3-40	1149						f	g	h
4	Sweetheart	1115							g	h
4	UCD8-27	1085								h
3	Supareil	1056								

Table 5. Yield, midday canopy light interception and yield per unit PAR intercepted for the 2016 (top), and 2017 years (middle) and cumulative yield for both years (bottom) for the Madera RAVT.

2016

Madera

# reps	Variety or selection	Yield (kernel lbs/ac)										
4	Y-117-86-03	1995	a									
4	Self-fr-P16-013	1911	a	b								
4	Booth	1857	a	b	c							
3	Y-116-161-99	1804	a	b	c							
4	Kester (2-19e)	1783	a	b	c							
4	Capitola	1781	a	b	c							
4	Bennett	1770	a	b	c							
4	Aldrich	1724	a	b	c	d						
4	UCD-18-20	1680	a	b	c	d	e					
4	Jenette	1644	a	b	c	d	e					
4	Self-fr-P13-019	1606	a	b	c	d	e	f				
1	Y-121-42-99	1533	a	b	c	d	e	f	g			
4	UCD-1-16	1469	a	b	c	d	e	f	g			
4	Sweetheart	1429	a	b	c	d	e	f	g			
4	Y-117-91-03	1427	a	b	c	d	e	f	g			
4	Durango	1415	a	b	c	d	e	f	g			
4	Winters	1369		b	c	d	e	f	g			
104	**Nonpareil**	**1360**		**b**	**c**	**d**	**e**	**f**	**g**			
4	UCD-8-201	1310			c	d	e	f	g	h		
4	Eddie	1262			c	d	e	f	g	h		
4	UCD-8-27	1145				d	e	f	g	h		
4	Sterling	1112					e	f	g	h	i	
4	Folsom	1052						f	g	h	i	
4	Supareil	1010							g	h	i	
4	UCD-8-160	964							g	h	i	
4	UCD-1-232	954							g	h	i	
4	UCD-7-159	775								h	i	j
4	UCD-3-40	577									i	j k
4	UCD-1-271	409										j k
2	Wood Colony	24										k

# reps	Variety or selection	Midday canopy PAR interception (%)										
4	Capitola	61.1	a									
4	Folsom	56.6	a	b								
4	Sweetheart	54.4	a	b	c							
4	Booth	54.1	a	b	c	d						
4	Kester (2-19e)	53.5	a	b	c	d						
4	Sterling	52.0	a	b	c	d						
105	**Nonpareil**	**52.0**	**a**	**b**	**c**	**d**						
4	Eddie	51.7	a	b	c	d						
4	Supareil	50.9	a	b	c	d						
4	UCD-1-271	50.7	a	b	c	d						
4	Y-116-161-99	49.3	a	b	c	d						
4	Y-117-91-03	48.4	a	b	c	d						
4	Aldrich	48.2	a	b	c	d						
4	UCD-3-40	47.3	a	b	c	d						
4	Self-fr-P13-019	46.3	a	b	c	d						
1	Y-121-42-99	46.3	a	b	c	d						
4	Self-fr-P16-013	46.0	a	b	c	d						
4	UCD-18-20	45.9	a	b	c	d						
4	Y-117-86-03	45.2		b	c	d						
4	Durango	45.2		b	c	d						
4	Jenette	44.8		b	c	d						
4	UCD-8-201	42.3		b	c	d						
4	Bennett	42.2		b	c	d						
4	UCD-7-159	41.9		b	c	d						
4	Winters	41.1		b	c	d						
4	UCD-1-232	41.0		b	c	d						
4	UCD-8-27	38.8			c	d						
4	UCD-8-160	38.1				d						
4	UCD-1-16	38.1				d						
4	Wood Colony	23.4										e

# reps	Variety or selection	Yield per unit PAR intercepted										
4	Y-117-86-03	45.4	a									
4	Bennett	42.0	a	b								
4	Self-fr-P16-013	41.2	a	b								
4	UCD-1-16	38.4	a	b	c							
4	Jenette	38.0	a	b	c							
3	Y-116-161-99	37.4	a	b	c	d						
4	UCD-18-20	37.3	a	b	c	d						
4	Aldrich	36.3	a	b	c	d						
4	Self-fr-P13-019	34.5	a	b	c	d	e					
4	Booth	34.2	a	b	c	d	e					
4	Kester	33.2		b	c	d	e					
4	Winters	33.2		b	c	d	e					
1	Y-121-42-99	33.1		b	c	d	e					
4	UCD-8-201	31.3		b	c	d	e	f				
4	Durango	31.2		b	c	d	e	f				
4	Capitola	29.2			c	d	e	f	g			
4	Y-117-91-03	29.0			c	d	e	f	g			
4	UCD-8-27	28.3			c	d	e	f	g	h		
4	Sweetheart	27.2			c	d	e	f	g	h		
104	**Nonpareil**	**26.8**			**c**	**d**	**e**	**f**	**g**	**h**		
4	UCD-8-160	26.2				d	e	f	g	h		
4	Eddie	24.6					e	f	g	h		
4	UCD-1-232	23.5					e	f	g	h		
4	Sterling	21.3						f	g	h	i	
4	Supareil	20.1						f	g	h	i	
4	Folsom	18.5							g	h	i	
4	UCD-7-159	17.5								h	i	j
4	UCD-3-40	12.2									i	j
4	UCD-1-271	8.0										j k
2	Wood Colony	1.7										k

2017

Madera

# reps	Variety or selection	Yield (kernel lbs/ac)										
4	Y-116-161-99	2604	a									
83	**Nonpareil**	**2341**	**a**	**b**								
4	Booth	2247	a	b	c							
4	UCD-18-20	2226	a	b	c							
4	Capitola	2190	a	b	c	d						
4	Eddie	2167	a	b	c	d						
4	Winters	2066	a	b	c	d						
4	Y-117-91-03	2042	a	b	c	d						
4	Bennett	1977	a	b	c	d	e					
4	Self-fr-P16-013	1931	a	b	c	d	e					
4	Sterling	1889	a	b	c	d	e	f				
4	Kester (2-19e)	1840		b	c	d	e	f				
4	Durango	1827		b	c	d	e	f				
4	Folsom	1818		b	c	d	e	f				
4	Y-117-86-03	1807		b	c	d	e	f				
4	Supareil	1791		b	c	d	e	f	g			
4	Jenette	1783		b	c	d	e	f	g			
1	Y-121-42-99	1758		b	c	d	e	f	g			
4	UCD-8-201	1671		b	c	d	e	f	g			
4	UCD-1-16	1647		b	c	d	e	f	g			
4	UCD-8-160	1596		b	c	d	e	f	g			
4	UCD-1-232	1490			c	d	e	f	g			
4	UCD-7-159	1465			c	d	e	f	g			
4	Self-fr-P13-019	1417				d	e	f	g	h		
4	Aldrich	1413				d	e	f	g	h		
4	Sweetheart	1210					e	f	g	h	i	
4	UCD-1-271	1137						f	g	h	i	
4	UCD-8-27	1022							g	h	i	
4	UCD-3-40	708								h	i	
4	Wood Colony	675									i	

# reps	Variety or selection	Midday canopy PAR interception (%)										
4	Folsom	70.4	a									
4	Capitola	70.2	a									
4	UCD-1-271	66.0	a	b								
4	Sterling	65.9	a	b								
4	Booth	65.7	a	b								
4	Supareil	65.3	a	b	c							
4	Sweetheart	64.4	a	b	c							
4	UCD-3-40	62.6	a	b	c							
4	Kester (2-19e)	61.5	a	b	c	d						
4	Eddie	60.5	a	b	c	d						
1	Y-121-42-99	59.1	a	b	c	d						
105	**Nonpareil**	**59.0**	**a**	**b**	**c**	**d**						
4	Y-117-91-03	58.7	a	b	c	d						
4	Y-116-161-99	58.5	a	b	c	d						
4	Aldrich	57.7	a	b	c	d						
4	UCD-8-27	56.0	a	b	c	d	e					
4	Bennett	55.2	a	b	c	d	e					
4	Self-fr-P16-013	54.7	a	b	c	d	e					
4	Durango	52.9		b	c	d	e					
4	UCD-18-20	52.9		b	c	d	e					
4	Self-fr-P13-019	52.8		b	c	d	e					
4	UCD-7-159	52.5		b	c	d	e					
4	Y-117-86-03	52.3		b	c	d	e					
4	UCD-8-201	51.7		b	c	d	e					
4	Jenette	51.6		b	c	d	e					
4	Winters	51.0		b	c	d	e					
4	UCD-1-232	49.5			c	d	e					
4	UCD-1-16	46.1				d	e					
4	UCD-8-160	46.0				d	e					
4	Wood Colony	41.2										e

# reps	Variety or selection	Midday canopy PAR interception (%)										
4	Y-116-161-99	44.5	a									
4	UCD-18-20	41.8	a	b								
84	**Nonpareil**	**40.7**	**a**	**b**								
4	Winters	39.7	a	b	c							
4	Bennett	36.5	a	b	c	d						
4	UCD-1-16	36.2	a	b	c	d	e					
4	Self-fr-P16-013	36.0	a	b	c	d	e					
4	Eddie	35.5	a	b	c	d	e					
4	UCD-8-160	35.5	a	b	c	d	e					
4	Y-117-91-03	35.1	a	b	c	d	e					
4	Durango	34.7	a	b	c	d	e					
4	Jenette	34.6	a	b	c	d	e					
4	Y-117-86-03	34.6	a	b	c	d	e					
4	Booth	34.1	a	b	c	d	e					
4	UCD-8-201	32.0		b	c	d	e					
4	Capitola	31.3		b	c	d	e					
4	UCD-1-232	29.9			c	d	e					
4	Kester (2-19e)	29.9			c	d	e					
1	Y-121-42-99	29.7			c	d	e					
4	Sterling	28.5				d	e					
4	Supareil	27.6				d	e	f				
4	UCD-7-159	26.9				d	e	f	g			
4	Self-fr-P13-019	26.0				d	e	f	g	h		
4	Folsom	25.7					e	f	g	h		
4	Aldrich	25.4					e	f	g	h		
4	UCD-8-27	18.1						f	g	h	i	
4	Sweetheart	17.6							g	h	i	
4	UCD-1-271	17.2							g	h	i	
4	Wood Colony	16.7								h	i	
4	UCD-3-40	11.5									i	

Cumulative 2017-2018

Madera

# reps	Variety or selection	Yield (kernel lbs/ac)											
3	Y-116-161-99	4782	a										
4	Booth	4103	a	b									
4	Capitola	3971	a	b	c								
4	UCD-18-20	3905	a	b	c	d							
4	Self-fr-P16-013	3842	a	b	c	d							
4	Y-117-86-03	3801	a	b	c	d							
4	Bennett	3747	a	b	c	d	e						
83	**Nonpareil**	**3641**		**b**	**c**	**d**	**e**	**f**					
4	Kester	3623		b	c	d	e	f					
4	Y-117-91-03	3469		b	c	d	e	f	g				
4	Winters	3435		b	c	d	e	f	g				
4	Eddie	3429		b	c	d	e	f	g				
4	Jenette	3427		b	c	d	e	f	g				
1	Y-121-42-99	3290		b	c	d	e	f	g	h			
4	Durango	3242		b	c	d	e	f	g	h	i		
4	Aldrich	3137		b	c	d	e	f	g	h	i		
4	UCD-1-16	3116		b	c	d	e	f	g	h	i		
4	Self-fr-P13-019	3023		b	c	d	e	f	g	h	i		
4	Sterling	3001		b	c	d	e	f	g	h	i		
4	UCD-8-201	2981			c	d	e	f	g	h	i		
4	Folsom	2870			c	d	e	f	g	h	i		
4	Supareil	2801				d	e	f	g	h	i		
4	Sweetheart	2639					e	f	g	h	i		
4	UCD-8-160	2559						f	g	h	i		
4	UCD-1-232	2444							g	h	i	j	
4	UCD-7-159	2240								h	i	j	k
4	UCD-8-27	2167									i	j	k
4	UCD-1-271	1546										j	k
4	UCD-3-40	1285											k l
2	Wood Colony	587											l

Table 6. Relative number of mummies left on tree after shaking at the Madera trial in 2016. Ratings categories are described below. Although this might give some idea about relative ease of shaking, it is likely confused by the fact that not all varieties or selections were shaken at their ideal time. Varieties and selections are rated from least mummies at top to most at bottom. Wood Colony was planted in place of Lonestar at the Madera trial and is one year younger and was not harvested.

Variety or selection	Relative mummy count rating
UCD1-16	1
Y116-161-99	1
Y117-91-03	1
Y121-42-99	1
Eddie	1
Y117-86-03	2
Jenette	2
Aldrich	2
Self-fr P13.019	2
UCD8-27	2
Self-fr P16.013	2
Capitola	2
UCD1-232	3
Supareil	3
Durango	3
Marcona	3
Bennett	3
Booth	3
UCD3-40	3
Nonpareil	3
Sweetheart	4
UCD8-160	4
Winters	5
2-19E	5
UCD1-271	5
UCD8-201	5
Sterling	5
Folsom	5
UCD7-159	5
Wood Colony	one year behind

Rating categories

1 = < 20/tree

2 = 20-49

3 = 50-99

4 = 100-199

5 = > 200

Table 7. Relative number of mummies left on tree after shaking at the Butte, Stanislaus, and Madera trials in 2017. Although this might give some idea about relative ease of shaking, it is likely complicated by the fact that not all varieties or selections were shaken at their ideal time, and the presence of hull rot at the Madera site. Ease of knocking was rated with the following scale after shaking and before poling: 1=fewer than 20 mummies per tree, 2=20-50 mummies, 3=50-100, 4=100-200, 5=200-500, 6= over 500.

	Butte County	Stanislaus County	Madera County
Folsom	1	2	4
Y121-42-99	2	5	4
Eddie	2	1	2
Y116-161-99	2	3	1
Aldrich	2	1	3
P16.013	2	1	4
Supareil	2	1	2
3-40	2	2	3
Nonpareil	2	1	4
Capitola	2	2	2
Bennett	3	2	3
Y117-91-03	3	3	2
Y117-86-03	3	3	1
Booth	3	3	4
Wood Colony	3	-	1
Durango	4	1	3
Winters	4	2	3
1-16	4	2	3
18-20	4	1	2
Jenette	4	3	3
P13.019	4	2	4
8-27	4	3	2
Sweetheart	4	6	3
Sterling	4	5	5
Kester / Hansen	4	5	4
1-232	5	3	4
Kester	5	5	-
7-159	5	5	5
8-160	5	1	3
8-201	5	3	4
1-271	6	6	4

Table 8. Main kernel defects for 2016 harvest. Items are listed if they had 6% or more of kernels exhibiting the defect.

	Trial					
Varieties with defect	**Butte**	**(%)**	**Stanislaus**	**(%)**	**Madera**	**(%)**
Double kernels	UCD 18-20	15	Booth	22	UCD8-201	25
(both ovules in ovary developed)	UCD 8-201	14	UCD 18-20	21	Y121-42-99	20
	Booth	12	UCD 8-201	17	Booth	16
	Self-Fru P16.013	10	P16-013	14	UCD1-232	7
	UCD 1-232	10	Y121-42-99	10	Y117-86-03	7
	Jenette	8	P13-019	8	UCD18-20	6
	UCD 8-27	7	Capitola	6	UCD8-27	6
	UCD 1-16	6				
	UCD 8-160	6				
Twin kernels	UCD 3-40	27	Jenette	21	UCD8-201	18
(two kernels within the same pellicle)	Sweetheart	20	UCD 8-27	19	Kester	12
	Jenette	19	UCD 3-40	16	Jenette	12
	UCD 8-201	17	Sweetheart	12	Sweetheart	6
	UCD 8-27	13	Folsom	11	Wood Colony	6
	UCD 8-160	11	P16-013	11		
	Nonpareil	11	UCD 8-160	10		
	Kester	8	UCD 8-201	10		
	Bennett	8	Booth	9		
	UCD 7-159	8	Kester/Hanser	9		
	Kester/Hansen	7	Capitola	9		
	Eddie	7	Kester	9		
	UCD 1-232	7	Supareil	7		
	Y-117-91-03	6	Aldrich	7		
			Nonpareil	7		
			Durango	7		
			UCD 1-232	7		
			UCD 7-159	7		
Naval orange worm damage	(none)		Booth	14	(none)	
			Y116-161-99	8		
			Eddie	7		
Blank kernels	UCD 1-232	10	Folsom	13	(none)	
			Booth	11		
			UCD 1-232	11		
			UCD 8-27	9		
			UCD 7-159	7		
Severe shrivel	Capitola	12	Capitola	24	Folsom	14
	Folsom	12	UCD 7-159	23	Wood Colony	8
	Self Fru P13.019	11	Folsom	19	Eddie	7
	Supareil	8	UCD 8-201	18	Booth	6
	Y-117-91-03	8	Y117-86-03	17	UCD8-27	6
	Bennett	7	Jenette	16	Y117-91-03	6
	Y117-86-03	7	UCD 8-160	16		
	UCD 1-271	7	UCD 8-27	15		
	Self-Fru P16.013	6	Bennett	11		
	Sweetheart	6	Booth	11		
	UCD 8-201	6	Sweetheart	11		
			UCD 1-232	11		
			Supareil	10		
			P16-013	9		
			Sterling	8		
			UCD 1-271	8		
			UCD 18-20	8		
			Durango	7		
			P13-019	7		
			Y117-91-03	7		
			UCD 1-16	7		
			Kester	7		
			UCD 3-40	6		

Table 9. Main kernel defects for 2017 harvest. Items are listed if they had 6% or more of kernels exhibiting the defect.

	Trial					
Varieties with defect	**Butte**	**(%)**	**Stanislaus**	**(%)**	**Madera**	**(%)**
6% or more double kernels	UCD 18-20	41	UCD 18-20	22	UCD 8-201	36
	Self-fru P16.013	37	UCD 8-201	18	Booth	22
	Booth	30	Booth	16	UCD 18-20	20
	UCD 8-201	26	Y121-42-99	16	UCD 8-27	18
	Wood Colony	24	Self-fru P16.013	15	Self-fru P16.013	13
	UCD 8-27	21	UCD 8-27	15	UCD 1-16	8
	UCD 8-160	20	Self-fru P16.013	14	Durango	7
	UCD 1-232	19	UCD 1-16	11	UCD 1-232	7
	Self-fru p13.019	19	Jenette	8		
	UCD 1-16	18	Durango	7		
	Jenette	14	Y117-91-03	6		
	Durango	13				
	Aldrich	9				
	Winters	9				
	Folsom	8				
	Kester	7				
	Bennett	7				
6% or more twin kernels	UCD 8-27	18	UCD 3-40	14	UCD 3-40	28
(two kernels within the	UCD 3-40	12	UCD 8-27	11	Jenette	9
same pellicle)	Sweetheart	10	Jenette	9	UCD 8-27	8
	Nonpareil	9	UCD 8-201	8	UCD 8-201	7
	UCD 1-232	7	UCD 8-160	7	2-19E	7
	UCD 8-160	7	Self-fru P16.013	7	UCD 7-159	6
	Booth	6				
	Jenette	6				
	UCD 8-201	6				
6% or more navel orange worm damage	UCD 8-27	6	UCD 8-27	8	UCD 1-271	14
					UCD 8-27	11
					UCD 8-201	8
					Supareil	7
					Bennett	7
					UCD 3-40	7
6% or more blank kernels	Self-fru P16.013	16	(none)		(none)	
	Booth	14				
	Y121-42-99	12				
	UCD 18-20	9				
	Jenette	6				
6% or more severe shrivel	Folsom	21	Jenette	10	Folsom	10
	Y117-86-03	17	UCD 8-201	8	Jenette	9
	Eddie	16	Y117-86-03	6	UCD 8-201	8
	Self-fru P16.013	14			Self-fru P13.019	7
	UCD 8-201	13			Wood Colony	7
	Capitola	13			Supareil	6
	UCD 8-27	12			UCD 8-27	6
	Y117-91-03	11				
	UCD 3-40	10				
	Y116-161-99	9				
	Self-fru p13.019	8				
	Sweetheart	8				
	UCD 1-232	8				
	UCD 8-160	8				
	UCD 1-16	8				
	Jenette	7				
	Supareil	6				
	UCD 18-20	6				

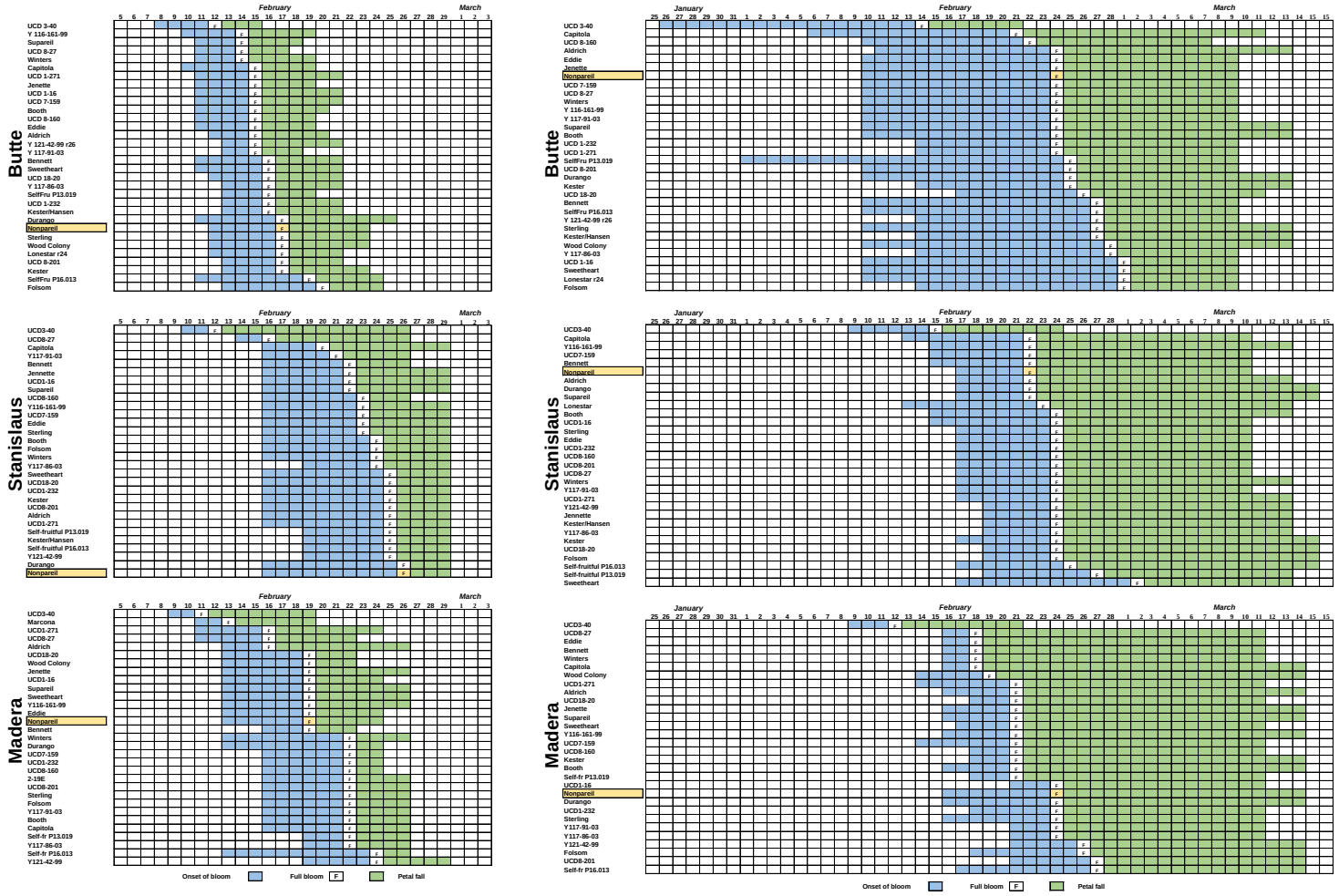

Figure 1. Bloom data for 2016 (left) and 2017 (right) by site and variety or selection.

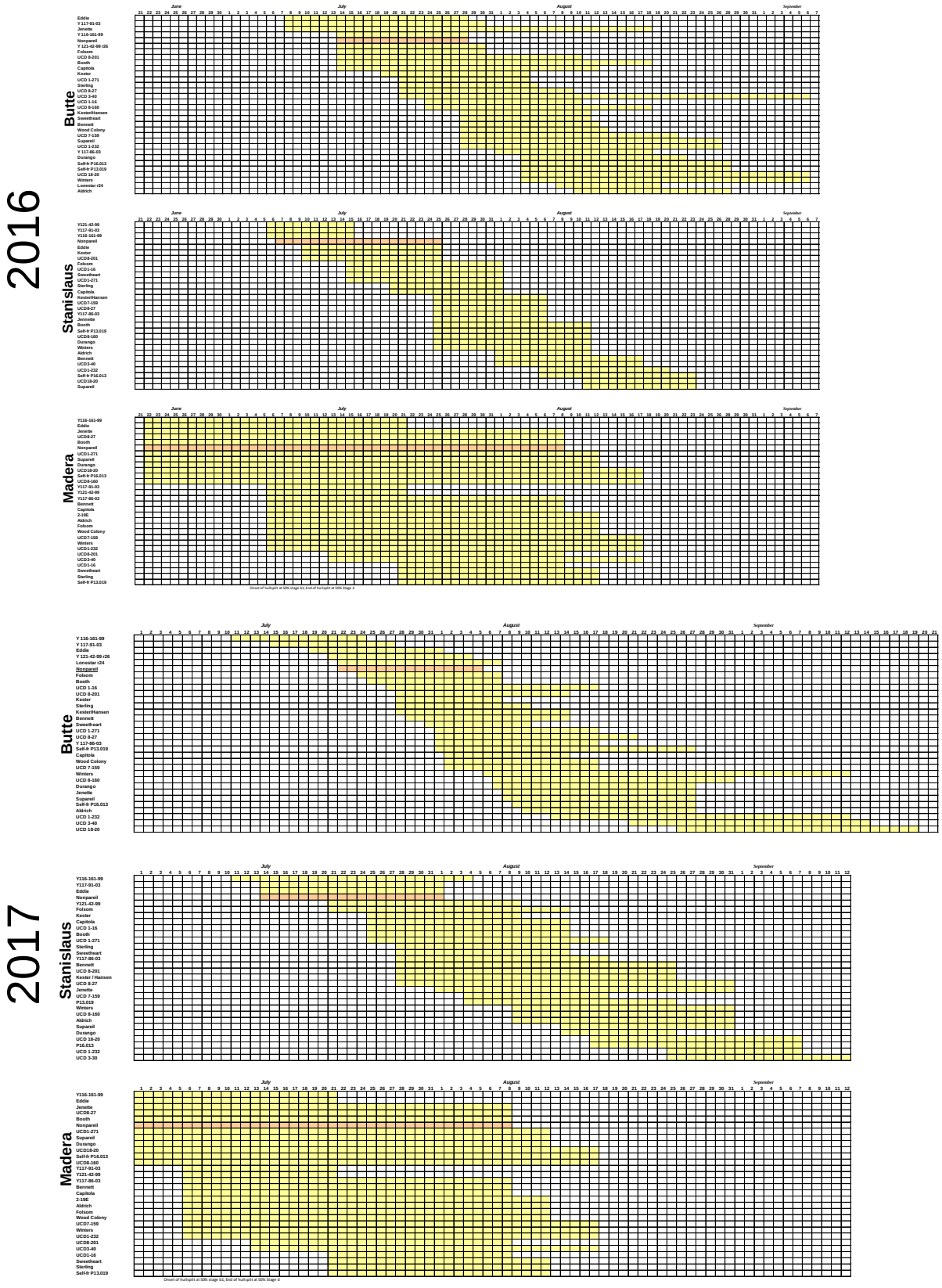

Figure 2. Hullsplit by site, variety and selection for 2016 (top) and 2017 (bottom).

Site	Trees per acre	2016 (kernel lb/ac)	2017 (kernel lb/ac)
Butte	110	159-796	405-2145
Stanislaus	130	40-460	907-2058
Madera	173	410-1999	708-2604

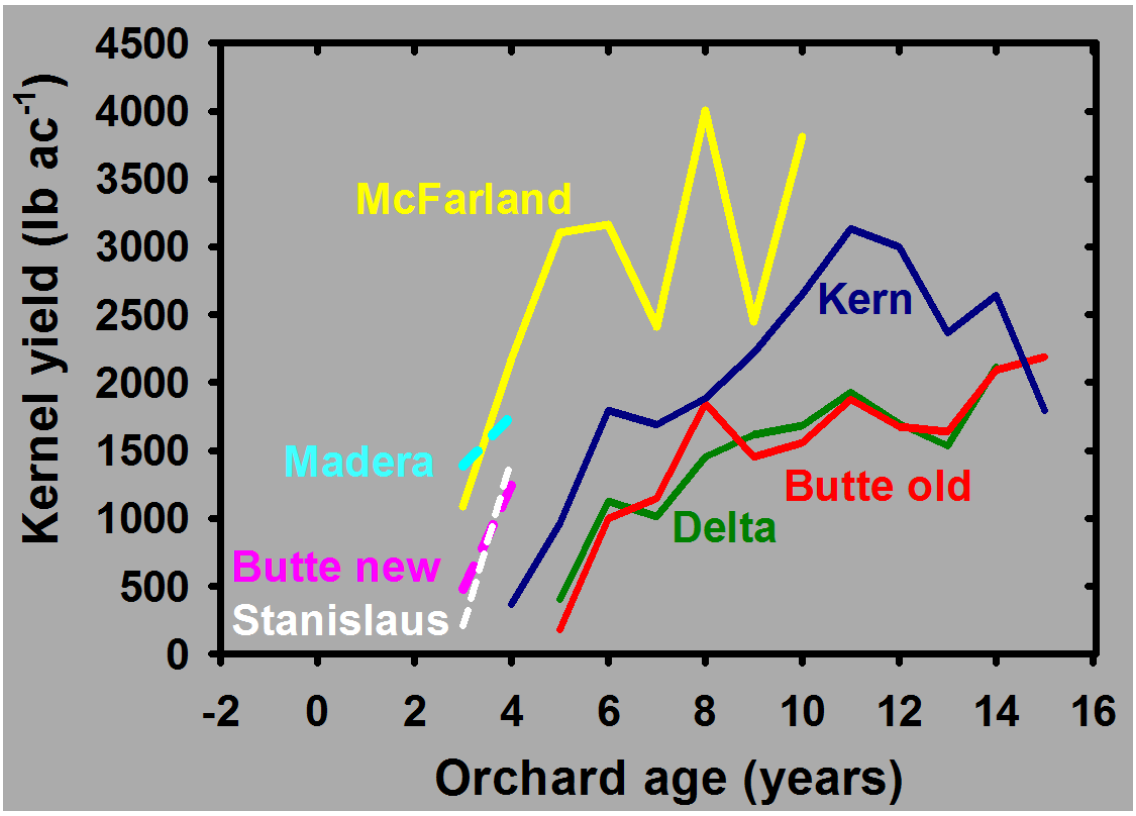

Figure 3. Average yield for all varieties, selections and Nonpareil sources by orchard age for the 1993 Butte (64 trees per acre), Delta (75 trees per acre) and Kern (86 trees per acre) Regional Almond Variety Trials as well as the McFarland Variety Trial that was planted in 2004 at a density of 121 trees per acre. Data for the 2014 trials is shown on the left. Madera, Butte new and Stanislaus trials have tree densities of 110, 130 and 173 trees per acre respectively.

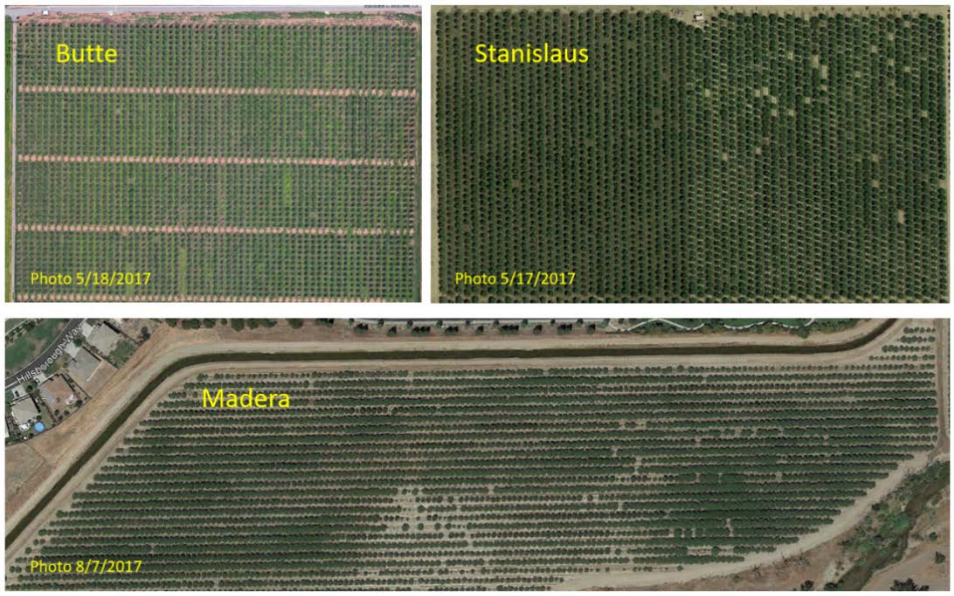

Figure 4. Google Earth images of the three sites. Note extensive tree loss in several areas at the Madera trial and to a lesser extent at the Stanislaus trial.

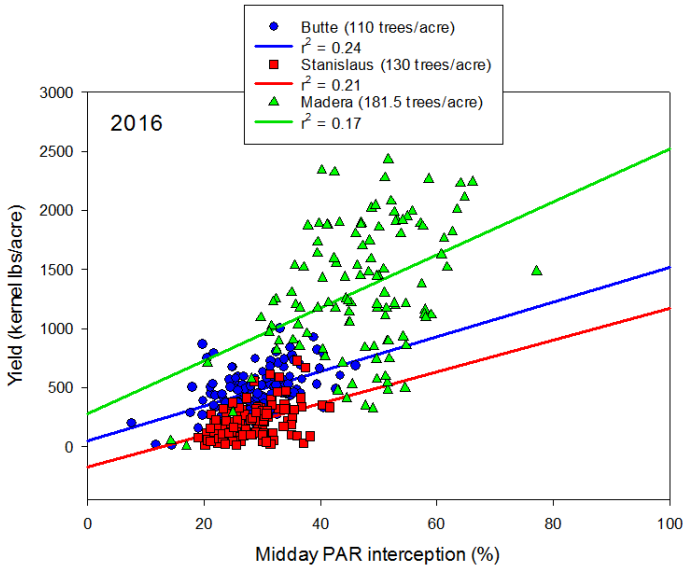

Figure 5. Midday canopy photosynthetically active radiation interception (PAR) versus kernel pounds per acre yield by site for 2016.

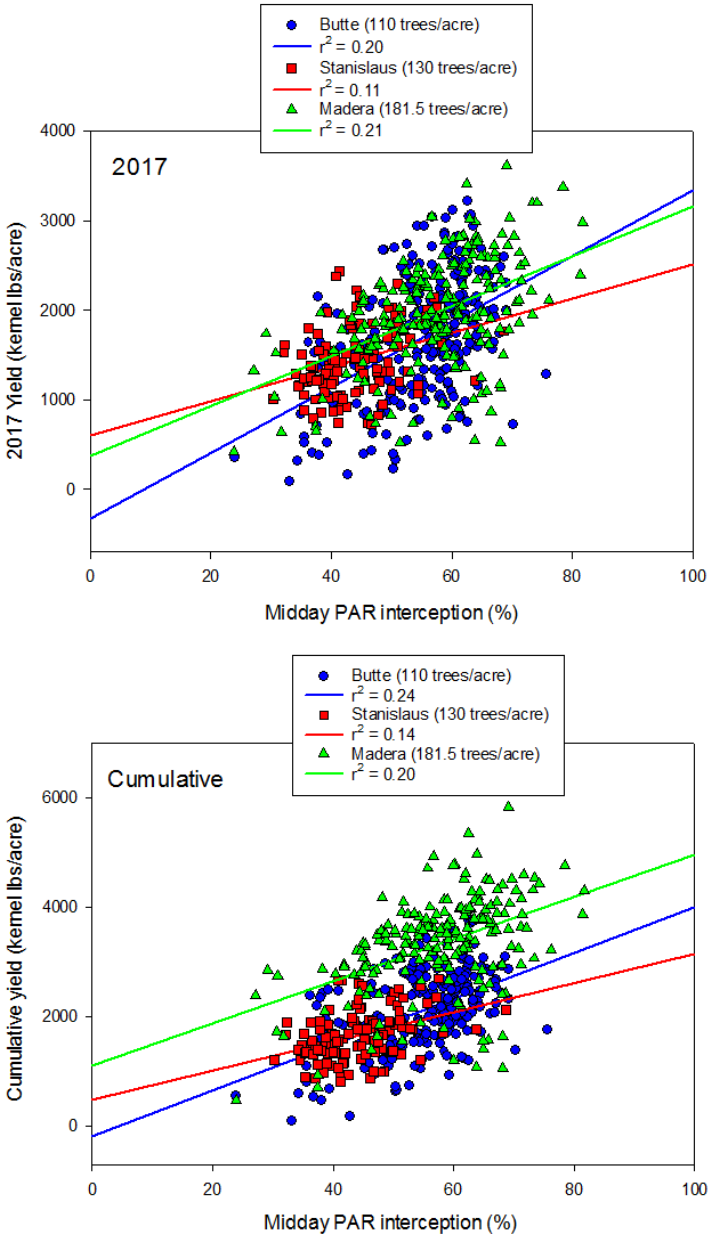

Figure 6. Midday canopy photosynthetically active radiation interception (PAR) versus kernel pounds per acre yield by site for 2017 (top) and cumulative per acre yield by site for 2016-2017 (bottom).